Appendix C

Description of Waste Volumes for the Hanford Site Solid (Radioactive and Hazardous) Waste Program EIS

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The waste volumes used in the Hanford Site Solid (Radioactive and Hazardous) Waste Program Environmental Impact Statement (HSW EIS) are based on analysis of the waste type options considered in the following sources: the Solid Waste Integrated Forecast Technical (SWIFT) Report (Barcot 1999, 2002), the Solid Waste Information and Tracking System (SWITS) (FH 2003), the Waste Management Programmatic Environmental Impact Statement (WM PEIS) (DOE 1997), Accelerating Cleanup: Paths to Closure (ACPC) (DOE 1998), the Transuranic Waste Performance Management Plan (DOE 2002), Tank Waste Remediation System (TWRS) EIS, and Conceptual Design Report Immobilized Low-Activity Waste Disposal Facility, Project W-520 (Burbank 2001). These sources are believed to include all low-level waste (LLW), mixed low-level waste (MLLW), and transuranic (TRU) waste that potentially could be shipped to Hanford for processing or disposal. In addition, a review of potential offsite waste receipts was conducted by the U.S. Department of Energy Richland Operations Office (DOE-RL) to determine lower and upper bound cases of offsite receipts.

Throughout the development of the HSW EIS, the waste volumes have been periodically reviewed to ensure the volumes used for analysis are representative of the latest available information. A comparison to the most recent versions of the SWIFT Report and the Integrated Planning, Accountability and Budgeting System (IPABS) (https://ipabs-is.em.doe.gov/ipabs/) showed that the LLW and MLLW volumes developed in fiscal year (FY) 1999 and FY 2000 were only slightly different than the most up-to-date information and that these volumes could continue to be used. Estimates for TRU waste, however, had increased substantially from previous estimates. Therefore, updated information was obtained from the SWIFT Report (Barcot 2002) to more accurately reflect the currently projected quantity of waste to be managed. In addition, recent planning by DOE to accelerate disposal of TRU waste has recommended the creation of a western hub to certify TRU waste from small-quantity sites for shipment to the Waste Isolation Pilot Plant (WIPP).

The HSW EIS used three different sets of volume data to assess the environmental impacts associated with 1) managing only wastes currently existing at Hanford or expected to be generated by Hanford activities and 2) receiving and managing waste from other DOE sites. The first set of data is defined as the Hanford Only volume and includes the following:

- Existing waste either previously disposed of or in storage as of October 1, 2001, according to the SWITS database version 01.01.00.

- Forecasted LLW and MLLW from onsite generators as defined in the 1999 SWIFT Report (Barcot 1999).

- Forecasted TRU waste from onsite generators as defined in the 2002 SWIFT Report (Barcot 2002).

- Estimates of immobilized low-activity waste (ILAW) and melters generated by the Waste Treatment Plant (WTP). ILAW estimates were obtained from the TWRS EIS (DOE and Ecology 1996) and RPP-7908. Estimates for melters were obtained from an Interface Control Document (ICD) (BNFL 1999) prepared under a contract to privatize the vitrification of high-level tank waste. These estimates were later reviewed against current plans for a DOE-owned facility to ensure the numbers contained in the ICD provided a bounding analysis.

The second set of data is referred to as the Lower Bound volume. This data set includes all waste included in the Hanford Only case as well as wastes from offsite generators approved for shipment to Hanford. Estimates for future receipts of LLW and MLLW from offsite generators were obtained from the 1999 SWIFT report while estimates for future TRU waste receipts were obtained from the 2002 SWIFT report.

The third set of data is defined as the Upper Bound volume and includes the Lower Bound volume as well as future offsite waste not reported in the SWIFT Report, but that may be managed at the Hanford Site. These potential additional offsite volumes were identified in the ACPC and the Transuranic Waste Performance Management Plan and reviewed by DOE-RL. The following section presents the three sets of volumes obtained from the sources mentioned above and describes the methodology for determining the appropriate volumes for the Upper Bound.

C.1 Volume Identification, Review, and Selection Methodology

As mentioned above, the waste volumes analyzed in the HSW EIS were obtained from a variety of sources. The criteria and assumptions used to develop the data in these sources varied depending when the data were developed and on the intended use of the data. For example, the data contained in the WM PEIS represent a 20-year period whereas the ACPC data represent the full life cycle of each site. In addition, the sources did not necessarily indicate where waste from a particular site would be dispositioned. Therefore, the sources were evaluated to determine the most appropriate data to use for each site. The data sources were reviewed using the following criteria:

- currency of the data (for example, which reference was the most recent)

- estimate duration (for example, was the forecast for the full life cycle or 20 years)

- previous shipments to Hanford (for example, did the waste generator have an established shipping agreement)

- previous shipments to Nevada Test Site (NTS) (for example, if the generator already shipped to NTS, it was likely that future shipments would continue to go to NTS).

Final selection of offsite forecast waste volume data was determined by a DOE-RL review. This review consisted of discussions with other DOE sites and DOE Headquarters to verify the amount of

waste to be disposed of and to determine the likelihood of waste volumes being sent to Hanford. Unless alternate disposition pathways were clearly the preferred option, waste volumes were included in the Upper Bound volume to ensure a bounding assessment. Table C.1 contains a comparison of the various volume sources and the results of the DOE-RL review. The total waste volumes resulting from the DOE-RL review were used in the HSW EIS analyses.

Sections C.2 through C.5 delineate the volumes by waste type that are used in the HSW EIS and the assumptions used in developing the volumes.

Table C.1. Comparison of Waste Management Programmatic Environmental Impact Statement, Accelerated Cleanup: Paths to Closure, and HSW EIS Waste Volumes (m^3)

Waste Type	Reporting/Generating Site	WM PEIS 20 Yrs	WM PEIS to 2050	ACPC Disposition Maps	HSW EIS		
					Hanford Only	Lower Bound	Upper Bound
LLW	Ames Laboratory (Ames, Iowa)	34	86	97		75	75
	Argonne National Laboratory-East	4,455	10,394	12,960		11,366	11,366
	Battelle Columbus Laboratory	9,192	9,192	1,478		774	774
	Bettis Atomic Power Laboratory					549	549
	Bettis Atomic Power Shipyards					1	1
	Brookhaven National Laboratory	23,179	30,934	1,090		1,574	14,894
	Energy Technology Engineering Center	3,401	3,401	2,355		1,428	1,428
	Fermi National Accelerator Laboratory			1,490		1,627	1,627
	Fernald Environmental Management Project	83,591	83,591				0
	General Atomics	337	337	704		0	0
	General Electric Vallencitos	20	20				20
	Grand Junction Projects Office	55	55				55
	Hanford Site[(a)]	148,530	230,924	98,760	411,765	411,765	411,765
	Idaho National Engineering and Environmental Laboratory	6,419	24,860	50,873			6,419
	Inhalation Toxicology Research Institute	670	1,693	2,344			670
	Knolls Atomic Power Shipyards					356	356
	Los Alamos National Laboratory	25,235	73,045				0
	Lawrence Berkeley National Laboratory	209	348	434		174	174
	Laboratory for Energy-Related Health Research/University of California at Davis	1,996		7,421		0	0
	Lawrence Livermore National Laboratory	10,975	27,310				10,975
	Massachusetts Institute of Technology/Bates Linear Accelerator Center			39		11	11
	Mound Plant	64,177	64,177				0
	Oak Ridge National Laboratory	78,883	202,219	259,830			78,883
	Paducah Gaseous Diffusion Plant	4,379	4,379			46	46

Table C.1. (contd)

Waste Type	Reporting/Generating Site	WM PEIS 20 Yrs	WM PEIS to 2050	ACPC Disposition Maps	HSW EIS		
					Hanford Only	Lower Bound	Upper Bound
LLW (contd)	Pantex Facility	1,205	1,329	1,198			1,205
	Portsmouth Gaseous Diffusion Plant	2,031	2,031			0	0
	Princeton Plasma Physics Laboratory	688	1,480	2,572		2,081	2,081
	Rocky Flats Plant	65,033	65,033	396			65,033
	Sandia National Laboratories	2,748	4,193	5,745			2,748
	Separations Process Research Unit	8,220	8,220				8,220
	Stanford Linear Accelerator Center			774		756	756
	West Valley Nuclear Services	11,297	11,297				11,297
LLW Total		556,959	860,540	450,560	411,765	432,582	631,427
MLLW	Battelle Columbus Laboratory			9		<1	<1
	Energy Technology Engineering Center	1,365	1,365				1,365
	Hanford Site	69,225	99,074	72,217	58,414	58,414	58,414
	Idaho National Engineering and Environmental Laboratory			196			196
	Knolls Atomic Power Laboratory					6	6
	Los Alamos National Laboratory	3,373	3,373				3,373
	Oak Ridge National Laboratory	25,462	55,323	68,625			55,323
	Paducah Gaseous Diffusion Plant	2,672	2,681	1,730			2,681
	Pearl Harbor Naval Shipyard					<1	<1
	Portsmouth Gaseous Diffusion Plant	2,933	2,933				2,933
	Princeton Plasma Physics Laboratory			2		91	91
	Puget Sound Naval Shipyard					3	3
	Rocky Flats Plant (SWIFT Maximum = 63,040)	68,144	68,146	67,934			68,144
	Sandia National Laboratories	158	160				159
	Savannah River Site	4,085	6,134	3,191			6,134
	West Valley Nuclear Services	26	26				26
MLLW Total		177,443	239,215	213,904	58,414	58,515	198,852
TRU[(b)]	Battelle Columbus Laboratory					28	28
	Energy Technology Engineering Center					19	19
	Framatome ANP					9	9
	Hanford Site				45,748	45,748	45,748
	Missouri University Research Reactor					2	2
	Transuranic Waste PMP Small-Quantity Sites						1,500
TRU Total					45,748	45,805	47,305
WTP Wastes	Immobilized Low-Activity Waste[(c)]				211,000	211,000	211,000
	Melters				6,825	6,825	6,825
WTP Total					217,825	217,825	217,825

(a) HSW EIS volumes for LLW include 283,067 m^3 of previously disposed waste.
(b) WM PEIS did not report TRU waste volumes for these sites.
(c) The No Action Alternative assumes a volume of 350,000 m^3.

C.2 Low-Level Waste

The Hanford Only volume includes all inventory and disposed of waste as of October 2001 (i.e., the existing waste in the Low Level Burial Grounds [LLBGs] and in storage) and onsite life-cycle forecasted waste. Table C.2 displays the Hanford Only volume for LLW.

Table C.2. Hanford Only Volume for Low-Level Waste (m^3)

Previously Disposed of	Disposed of FY99-FY01	Storage Inventory (10/2001)	Onsite Waste Forecast (Barcot 1999)	Total
283,067	21,717	299	106,681	411,765

The assumptions used for preparing the LLW Hanford Only volume include the following:

- Forecast estimates were included for the years 2002 through 2046.

- Onsite forecasted volumes were obtained from the 1999 version of the SWIFT Report for the time period 2002 through 2046. To ensure data consistency, the forecast volumes in the SWIFT Report were compared to the most current estimates included in the 2002 version. The 2002 forecast for LLW is nearly identical to the 1999 forecast for the same time period. Therefore, updating the volume estimates would not significantly change the environmental impacts and the forecast from 1999 will continue to be used to minimize cost and schedule. The forecast volumes for FY 1999 to FY 2001 were deleted from the analysis, however, because these volumes are accounted for in the volume of waste disposed of or in storage.

- The storage inventory waste volume is current as of October 2001 and was obtained from the SWITS database.

- Estimates for previously disposed of LLW and waste disposed of from FY 1999 to FY 2001 were obtained from the SWITS database.

- All waste will be verified by sampling a fraction of the waste received at the Hanford Site.

The LLW Lower Bound volume includes the Hanford Only volume plus additional forecasted waste from offsite waste generators approved for shipment to the Hanford Site. Table C.3 displays the Lower Bound volume for LLW.

Table C.3. Lower Bound Volume for Low-Level Waste (m^3)

Previously Disposed of	Disposed of FY99-FY01	Storage Inventory (10/2001)	Onsite Waste Forecast (Barcot 1999)	Offsite Waste Forecast (Barcot 1999)	Total
283,067	21,717	299	106,681	20,818	432,582

The assumptions used for preparing the Lower Bound LLW volume include the following:

- Forecast estimates were included for the years 2002 through 2046.

- Offsite forecasted waste generators include Ames Laboratory (Ames, Iowa), Argonne National Laboratory-East, Battelle Columbus Laboratory, Bettis Atomic Power Laboratory, Bettis Atomic Power Shipyards, Brookhaven National Laboratory, Energy Technology Engineering Center (also known as Rockwell-Canoga Park), Fermi National Accelerator Laboratory, Knolls Atomic Power Shipyards, Lawrence Berkeley National Laboratory, Laboratory for Energy-Related Health Research/University of California at Davis, Massachusetts Institute of Technology, Princeton Plasma Physics Laboratory, Paducah Gaseous Diffusion Plant, Portsmouth Gaseous Diffusion Plant, and Stanford Linear Accelerator Center. These are approved generators (Bilson 1998).

- Offsite forecasted volumes were obtained from the 1999 version of the SWIFT Report for the time period 2002 through 2046. To ensure data consistency, the forecast volumes in the SWIFT Report were compared to the most current estimates included in the 2002 version. The 2002 forecast for LLW is nearly identical to the 1999 forecast for the same time period. Therefore, updating the volume estimates would not significantly change the environmental impacts and the forecast from 1999 will continue to be used to minimize cost and schedule. The forecast volumes for FY 1999 to FY 2001 were deleted from the analysis, however, because these volumes are accounted for in the volume of waste disposed of or in storage.

The LLW Upper Bound volume includes the Lower Bound volume plus additional forecasted waste from offsite waste generators that may ship to the Hanford Site. The Upper Bound volume is derived from the WM PEIS Option 2 with some variation as described in the following assumption section. Table C.4 displays the Upper Bound volume for LLW.

Table C.4. Upper Bound Volume for Low-Level Waste (m^3)

Previously Disposed of	Disposed of FY99-FY01	Storage Inventory (10/2001)	Onsite Waste Forecast (1999 SWIFT)	Offsite Waste Forecast (1999 SWIFT)	Additional Offsite Waste	Total
283,067	21,717	299	106,681	20,818	198,845	631,427

The assumptions used to arrive at the Upper Bound volume for LLW include the following:

- Potential receipts from offsite generators in addition to the Lower Bound volumes were reviewed by DOE-RL with the following generators to determine the appropriate estimates for analysis: Brookhaven National Laboratory, General Electric Vallecitos, Grand Junction Project Office, Idaho National Engineering and Environmental Laboratory, Inhalation Toxicology Research Institute, Lawrence Livermore National Laboratory, Oak Ridge National Laboratory, Pantex Facility, Rocky Flats Plant, Sandia National Laboratory, Separations Process Research Unit, and West Valley Nuclear Services. The Upper Bound volume includes both the Lower Bound volume estimates and the additional offsite wastes.

- The 1999 SWIFT Report, the WM PEIS Option 2 waste volumes for Hanford and NTS, and the Environmental Management Integration (ACPC) disposition maps (DOE 1998) were used as the bases for the upper bound volume. These volumes were then further refined by DOE-RL and the generating sites to determine the volumes analyzed in the HSW EIS.

- Offsite waste volumes were included through 2046.

C.3 Mixed Low-Level Waste

The Hanford Only volume includes all inventory and disposed of waste as of October 2001 (i.e., the existing waste in the MLLW trenches and in storage) and onsite life-cycle forecasted waste. Table C.5 displays the Hanford Only volume for MLLW.

Table C.5. Hanford Only Volume for Mixed Low-Level Waste (m^3)

MLLW Trench Inventory (10/2001)	Storage Inventory (10/2001)	Onsite Waste Forecast (Barcot 1999)	Total
1,010	7,350	50,054	58,414

The assumptions used for preparing the Hanford Only MLLW volume include the following:

- Onsite forecasted volumes were obtained from the 1999 SWIFT Report for the time period 2002 through 2046. To ensure data consistency, the forecast volumes in the 1999 SWIFT Report were compared to the most current estimates included in 2002 Report. The 2002 forecast for MLLW is nearly identical to the 1999 forecast for the same time period. Therefore, updating the volume estimates would not significantly change the environmental impacts and the 1999 estimates will continue to be used to minimize cost and schedule. The forecast volumes for FY 1999 to FY 2001 were deleted from the analysis, however, because these volumes are accounted for in the MLLW trench inventory or in the storage inventory.

- Inventory waste is current as of October 2001 and was obtained from the SWITS database.

- Estimates for waste disposed from FY 1999 to FY 2001 were obtained from the SWITS database.

- Roughly half the onsite forecasted waste will require treatment before disposal at the Hanford Site. Large volumes of long-length contaminated equipment are expected to be received in a form that is treated and ready for disposal.

The Lower Bound volume includes the Hanford Only volume and additional forecasted offsite waste that has an approved site treatment plan. Table C.6 displays the Lower Bound volume for MLLW.

Table C.6. Lower Bound Volume for Mixed Low-Level Waste (m^3)

MLLW Trench Inventory (10/2001)	Storage Inventory (10/2001)	Onsite Waste Forecast (Barcot 1999)	Offsite Waste Forecast (Barcot 1999)	Total
1,010	7,350	50,054	101	58,515

The assumptions used for preparing the Lower Bound MLLW volume include the following:

- The following offsite generators forecast waste for shipment to Hanford in accordance with approved site treatment plans: Battelle Columbus Laboratory, Knolls Atomic Power Laboratory, Pearl Harbor Naval Shipyard, Princeton Plasma Physics Laboratory, and Puget Sound Naval Shipyard.

- Offsite forecasted volumes were obtained from the 1999 SWIFT Report for the time period 2002 through 2046. To ensure data consistency, the forecast volumes in the 1999 SWIFT Report were compared to the most current estimates included in 2002 Report. The 2002 forecast for MLLW is nearly identical to the 1999 forecast for the same time period. Therefore, updating the volume estimates would not significantly change the environmental impacts and the 1999 estimates will continue to be used to minimize cost and schedule. The forecast volumes for FY 1999 to FY 2001 were deleted from the analysis, however, because these volumes are accounted for in the MLLW trench inventory or in the storage inventory.

- Some site treatment plans for the offsite generators show the waste will be treated at Hanford and be shipped back to the sites for disposal. However, as the amount of this offsite waste is small compared to the total, this waste is assumed to be disposed of at Hanford.

The Upper Bound volume includes the Lower Bound volume, plus additional forecasted waste from offsite waste generators that are not currently shipping waste to the Hanford Site but may ship in the future as a result of the WM PEIS. Table C.7 displays the Upper Bound volume for MLLW.

Table C.7. Upper Bound Volume for Mixed Low-Level Waste (m^3)

MLLW Trench Inventory (10/2001)	Storage Inventory (10/2001)	Onsite Waste Forecast (Barcot 1999)	Offsite Waste Forecast (Barcot 1999)	Additional Offsite Waste	Total
1,010	7,350	50,054	101	140,334	198,852

The assumptions used to arrive at the Upper Bound volume for MLLW are described in the following:

- Additional offsite waste generators as confirmed by DOE-RL include Energy Technology Engineering Center, Idaho National Engineering and Environmental Laboratory, Los Alamos National Laboratory, Oak Ridge National Laboratory, Paducah Gaseous Diffusion Plant, Portsmouth Gaseous Diffusion Plant, Rocky Flats Plant, Sandia National Laboratories, Savannah River Site, and the West Valley Nuclear Services.

- Offsite waste volumes represent waste expected through the Hanford life cycle (2046).

- All offsite waste will be disposed of at Hanford.

- Additional waste volumes received from offsite generators are assumed to be received, treated, and ready for disposal and will not require treatment at the Hanford Site.

- Initial estimates for additional offsite waste volumes were based on the life-cycle volume estimates used in Option D of the WM PEIS and the Environmental Management Integration (ACPC) disposition maps (DOE 1998). The estimates included waste to be dispositioned at Hanford or waste with no identified disposition pathway. Waste designated for commercial treatment and disposal was not included. These volumes were then further refined by DOE-RL and the generating sites to determine the volumes analyzed in the HSW EIS.

C.4 Transuranic Waste

The Hanford Only volume includes all inventory waste as of October 2001 (i.e., the existing waste in storage) and onsite life-cycle forecasted waste. Table C.8 displays the Hanford Only volume for TRU waste.

Table C.8. Hanford Only Waste Volumes for Transuranic Waste (m^3)

Storage Inventory (10/2001)	Onsite Waste Forecast (Barcot 2002)	Total
16,136	29,613	45,748

The assumptions used to arrive at the Hanford Only case for TRU waste are described in the following list:

- Forecasted volumes were obtained from the 2002 SWIFT Report and collected for the life cycle of the Hanford Site (through 2046). The maximum forecast estimates were used to provide a bounding analysis.

- A comparison of the TRU waste volume estimates developed during FY 1999 and FY 2000 to the 2002 SWIFT Report showed that the expected waste volumes had increased significantly over the development period of the HSW EIS. Therefore, the waste volumes for TRU waste were updated to reflect the current forecast estimates.

- Inventory waste is current as of October 2001 and was obtained from the SWITS database.

- The TRU waste will be processed and certified at the Hanford Site and sent to WIPP.

The Lower Bound volume includes the Hanford Only volume and additional offsite waste included in the 2002 SWIFT Report. Table C.9 displays the Lower Bound volume for TRU waste.

Table C.9. Lower Bound Waste Volumes for Transuranic Waste (m^3)

Storage Inventory (10/2001)	Onsite Waste Forecast (Barcot 2002)	Offsite Waste Forecast (Barcot 2002)	Total
16,136	29,613	57	45,805

The assumptions used to arrive at the Lower Bound case for TRU waste are described in the following:

- Forecasted volumes from offsite generators were obtained from the 2002 SWIFT Report and collected for the life cycle of the Hanford Site (through 2046). The maximum forecast estimates were used to provide a bounding analysis.

- Waste from offsite generators is included for Battelle Columbus Laboratory, Energy Technology Engineering Center (ETEC), Framatome ANP, and Missouri University Research Reactor.

- The TRU waste will be processed and certified at the Hanford Site and sent to WIPP.

The Upper Bound volume includes the Lower Bound volume, plus additional waste from offsite waste generators that may be received in the future if Hanford is selected to receive waste from small-quantity sites as the western hub as part of DOE's efforts to accelerate the disposal of TRU waste (DOE 2002). Table C.10 displays the Upper Bound volume for TRU waste.

Table C.10. Upper Bound Waste Volumes for Transuranic Waste (m^3)

Storage Inventory (10/2001)	Onsite Waste Forecast (Barcot 2002)	Offsite Waste Forecast (Barcot 2002)	Additional Offsite Waste	Total
16,136	29,613	57	1,500	47,305

The following assumptions were used to develop the Upper Bound volume for TRU waste:

- The volume of TRU waste expected to be received from small-quantity sites by the western hub was obtained from the Transuranic Waste Performance Management Plan (DOE 2002). It is assumed the wastes from small quantity sites are in addition to the offsite wastes included in the Lower Bound volume. Decreasing the additional offsite waste volume by the offsite waste included in the Lower Bound would not significantly change the environmental impacts.

C.5 Waste Treatment Plant Wastes

Waste volumes expected from the Waste Treatment Plant are shown in Table C.11. As these wastes will only be generated at Hanford, the Lower Bound and Upper Bound cases are not applicable. The volume of ILAW generated by the WTP, however, may vary depending on the vitrified waste form produced. For the No Action Alternative, ILAW would be produced in a cullet form and packaged in containers for retrievable disposal in vaults as outlined in the TWRS EIS (DOE and Ecology 1996). The EIS analysis assumed 140,000 containers would be required or an equivalent volume of approximately 350,000 m^3. For the Action Alternatives, ILAW was assumed to be in a monolithic form and packaged in 2.6-m^3 containers for disposal in trenches. Approximately 81,000 containers would be required, or an equivalent volume of approximately 211,000 m^3 (Burbank 2001).

Table C.11. Estimated Volumes of WTP Waste Streams through 2046

Waste Streams	No Action (cubic meters)	Action Alternatives (cubic meters)
ILAW	350,000	211,000
WTP Melters	6,825	6,825
Total WTP Waste	356,825	217,825

C.6 References

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